SIE 565: Reasoning with uncertainty in spatial information systems

Credits: 3
Prerequisite: SIE 451 or SIE 550 or permission

Motivation

Uncertainty is a crucial factor in real-world information systems, and spatial uncertainty handling is an important component of general uncertainty considerations. The course provides a systematic and rigorous treatment of the topic and takes students to the level where current research questions are addressed.

Objective

To introduce participants to the kinds of uncertainty that arise in systems and approaches to uncertainty handling, particularly using techniques from artificial intelligence.

Course outline

Spatial reasoning.

General issues of uncertainty in information systems, observations as first class entities, qualitative vs. quantitative approaches, accuracy vs. precision, open vs. closed database semantics.

Typology of uncertainty in spatial information: imprecision, inaccuracy, inconsistency, vagueness.

Representation of spatial uncertainty in an information system: epsilon bands, egg-yolk model of spatial uncertainty, fuzzy regions.

Approaches to reasoning under uncertainty: classical logic, multi-valued logics of uncertainty, logics of possible worlds, probabilistic and Bayesian approaches, Dempster-Shafer theory of evidence, fuzzy set theory, rough set theory. Handling conflicting information.

The role of information theory.

Finite resolution computational models, multiresolution data models.

Inherently vague spatial information, qualitative treatments of distance and direction.

Delivery and Assessment

The course is taught as a combination of lectures and discussion sessions based on set reading. Students make presentations based on their reading of key papers. There will be two assessments, based on the student presentations, discussion groups and lecture material. The third assessment is based on a written report that presents a specific issue in spatial uncertainty handling.

Assessment weightings
Assessment 1 (30%)
- Presentation of 2 papers (delivery + accompanying notes) (20%)
- Commentary on the full set of papers presented by the group (10%)

Assessment 2 (40%)
- Participation in class (10%)
- Written Test (30%)

Assessment 3 (30%)
- Written report *and short presentation* on a specific issue in uncertainty handling (30%)

Course Web Site

Useful material can be downloaded from:

http://www.spatial.maine.edu/~worboys/SIE565/

Texts

There is no single text that covers this area. The main text is “Worboys and Duckham, GIS: A Computing Perspective, 2nd edition,” and within that the main chapter is “Chapter 9, Spatial Reasoning and Uncertainty.” Other resources may be found on the course Web site.

Instructor

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